TWO NEW SPECIES OF *PASSIFLORA* SECTION *DECALOBA* (PASSIFLORACEAE) FROM COSTA RICA

Living collections of two species of *Passiflora* L. section *Decaloba* DC. were made in Costa Rica and subsequently studied in cultivation. Both were found to represent undescribed species. The study of the living plants as well as herbarium specimens has allowed the following detailed descriptions. Color names follow the standardized English names system of the ISCC-NBS (1965).

Passiflora nubicola MacDougal, sp. nov. TYPE: cultivated at Duke University, 1980, from stem of *MacDougal 220* collected 27 Aug. 1977 in: Costa Rica. Puntarenas: Cordillera de Tilarán, road through Monteverde Cloud Forest Reserve, Pacific slope just below continental divide, ca. 1,540 m, *MacDougal 220GR* (holotype, DUKE; isotypes, BM, CR, MEXU, MO). Figure 1.

Passiflora scandens; petioli eglandulosi; folia bilobata vel trilobata, lobis obtusis vel truncatis, angulo inter lobos laterales 70–90(–100)°, lobis lateralibus quam centrali subaequalibus vel longioribus, marginibus integris; bracteae ad 1.4 mm longae; flores parvi albidi subpendentes; coronae filamenta uniseriata vel biseriata, filamentis exterioribus luteolis 2–3 mm longis; operculum plicatum; ovarium glabrum; semina 8–10 sulcata.

Gracile climbing perennial herb 1.5–3(–4) m long, lightly and minutely puberulent throughout at shoot tip (except laminas) with antrorsely appressed trichomes 0.04–0.10 mm long, becoming very sparsely puberulent or glabrescent on mature structures. Stem 1.5–3 mm diam., perennial with little secondary growth (several-year-old stems 3 mm diam., dark green, not woody), obtusely sub-5-angulate (drying acutely sulcate-striate) and 5–6-carinate, the carinae becoming verrucose and somewhat scabrous below; posture of shoot tip cernuous; phyllotaxy 2/5. Stipules 1–2(–2.5) × 0.15–0.25 mm, linear-triangular, falcate at base, necrescent. Petioles 0.8–2(–2.8) cm, eglandular. Laminas 2.2–4(–4.6) × 4–6(–9.2) cm at fertile nodes, depressed-obovate to strongly depressed-obovate or semicircular in general outline, adaxially glabrous, often with slight variegation consisting of a few discontinuous patches of white between (not along) the primary and secondary veins, abaxially very sparsely puberulent with trichomes restricted to primary and secondary veins, sometimes flushed purplish (especially new growth), margins entire, sparsely puberulent to nearly glabrous, shallowly (2–)3-lobed less than 0.15 the distance to the obtuse base, the lateral lobes obtuse to rounded or truncate, the central lobe (obsolete to) obtuse or truncate and sometimes emarginate, the angle between the primary lateral veins 70–90(–100)°, the ratio of lateral to central vein lengths 1.0–1.4, the ratio of laminar width to length 1.5–2.1; laminar nectaries 8–14(–18) per leaf (to 26 on immature plants), borne abaxially between the primary veins, often appearing light yellowish adaxially, the most proximal pair only occasionally strictly axillary but not enlarged; leaves of juvenile plants similar, variegated, vein ratio close to 1.0; seedlings unknown. Tendrils straight during development at shoot apex. Prophyll of vegetative ramifying bud 1, lanceolate, acuminate. Peduncles 1.0–2.0 cm, geminate, uniflorous; bracts 3, 0.7–1.4 × 0.05–0.25 mm, usually borne near apex of peduncle, linear-triangular, often involute near base and appearing narrowly lanceolate, early necrescent, stramineous. Flowers ca. 1.7–2 cm diam., subpendent, whitish with green and yellow corona, slightly sweetly odorous; floral stipe (3.0–)4–6.0 mm (to 5–9 mm in fruit); hypanthium 5–5.5 mm diam.; sepals 7.5–11 × 2.6–4.4 mm, oblong to oblong-lanceolate, rounded, ecorniculate, pale yellow-green abaxially, whitish adaxially; petals 5.0–7.5 × 2.4–3.4 mm, oblong to ovate-oblong, rounded, white; filamentous corona in 1–2 series, the outer filaments ca. 23–25, 2–3 mm, simply curved and spreading, thickest near the base, abaxially flattened, slightly laterally compressed, the apex obtuse or rounded, light yellowish green basally, bright yellow toward apex; inner series (if present) 1.8–2.2 mm, capillary, clavate or dilated at the apex, inclined toward androgynophore; operculum 0.9–1.5 mm, membra-

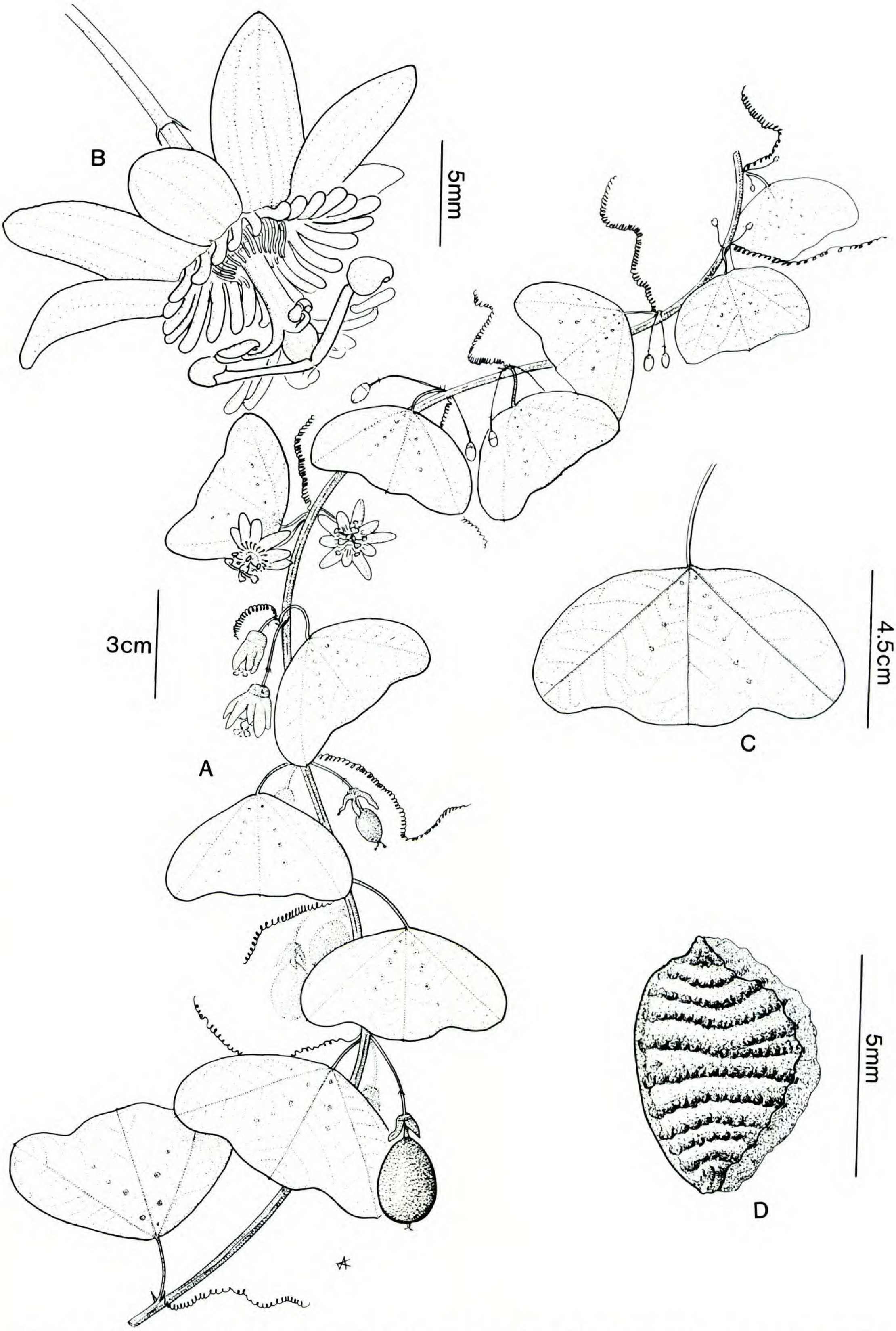

FIGURE 1. *Passiflora nubicola*.—A. Habit (*MacDougal 220GR*).—B. Flower (*MacDougal 220GR*).—C. Large leaf (*Brenes 6158*).—D. Seed with raphe (*Dryer 460*).

nous, plicate, pale yellow-green; nectary-trough without a raised annulus; limen (disk) ca. 2.5–2.7 mm diam., not colored or spotted; staminal filaments connate for 4.7–5.9 mm along the very pale green androgynophore, the free portions ca. 3–4 mm, pale yellowish green; anthers 2.2–2.5 mm, not marked with purple; ovary 2.0 × 1.8–2.0 mm, widely obovoid to widely ellipsoid, glabrous, light yellow green; styles ca. 4–5 mm, light yellow green; stigmas 1.5–2.4 mm diam., capitate. Fruit 1.8–2.5 × 1.8–2.1 cm, widely ellipsoid to very widely obovoid, obtusely trigonous in cross section, exocarp purplish or bluish black, glaucous, mesocarp spongy, white; arils no longer than seeds, clear, gelatinous; seeds 3.6–4.2(–4.5) mm long, 2.5–2.9 mm wide, 1.5–1.6 mm thick, obovate (to widely obovate), very slightly obcampylotropous (or nearly symmetric), transversely sulcate with (7–)8–10 sulcae, the ridges verrucose or knobbed, the chalazal beak erect to slightly inclined away from raphe. Chromosome number $n = 6$.

Additional specimens examined. COSTA RICA. ALAJUELA: Finca Johanson, Los Angeles de San Ramón, [ca. 10°09′N, 84°29′W], 11–12 Mar. 1928 (fl), *Brenes 6019* (F); camino de Finca Johanson, Los Angeles de San Ramón, 4 May 1928 (fl), *Brenes 6158* (F); road to Peñas Blancas from Monteverde ca. 2 km from continental divide, Atlantic slope, 1,400 m, 13 Apr. 1981 (fl, fr), *Knapp & Mallet 857* (TEX); road to Peñas Blancas ca. 3–4 km from divide, Atlantic slope, 1,300 m, 13 Apr. 1981 (fl), *Knapp & Mallet 858* (TEX). CARTAGO: Tapantí, 1,300–1,700 m, 26 Oct. 1983 (fl), *Chácon et al. 1530* (CR); ca. 1 km N and downstream of the junction of the Río Dos Amigos and the Río Grande de Orosi on the road to Tapantí, 1,500 m, 10 Aug. 1980, *MacDougal 1244* (DUKE). PUNTARENAS: vertiente Pacífico, Reserva, Monteverde, 1,520–1,580 m, 17 July 1976 (fr), *Dryer 460* (CR, F); 14 June 1977 (fr), *Dryer 1449* (F); 27 Aug. 1977, *MacDougal 220* (DUKE).

This small and inconspicuous passionflower is known from four areas of lower montane rainforest in Costa Rica. *Passiflora nubicola* grows at edges of primary forest, in treefalls, or along trails, where its thin wiry dark green stems trail over fallen logs and among grasses, bushes, and small trees. The leaves are similar in shape to those of a juvenile *P. biflora* Lam., and their flecks of white variegation are similarly distributed. The flower also resembles that of a miniature *P. biflora*, but in the Orosi valley possesses only one row of coronal filaments. The species is closely related to *P. biflora*.

At the Monteverde Reserve, the main herbivore of this species is *Heliconius clysonimus* (J. Mallet, pers. comm.).

The clone from the same plant as the holotype of this species was grown at Duke University 1977–1983, and the chromosome count was determined from the clones of this plant. Floral anthesis was around 0830 hrs. in the greenhouse, with the flowers closing in the early afternoon. No fruits were set by autogamy during cultivation, and more than 40 attempts at self-pollination also failed to produce fruit. *Passiflora nubicola* was very fertile in both directions with *P. biflora* (*MacDougal 260GR* & *275GR*), yielding well-seeded fruit and vigorous F_1 progeny. Those progeny, generally morphologically intermediate in vegetative and reproductive character states, had variously malformed flowers and were sterile, producing no viable pollen. Fruits (with hybrid embryos) produced on *P. nubicola* matured in 45–48 days and contained 35–64 seeds per fruit (N = 13 fruits).

The epithet means "cloud-dweller," in reference to its habitat of misty forest.

Passiflora gilbertiana MacDougal, sp. nov. TYPE: Costa Rica. San José: along roadcut 18.2 km S of Villa Mills on Pan-American Highway, 7,700 ft, 10 Aug. 1977, *L. E. Gilbert 8* (holotype, LL; isotypes: F, MO, MSC). Figures 2, 3B.

Passiflora scandens; petioli eglandulosi; folia supra vittata, infra purpureata vel atrovinoseata, bilobata vel trilobata, lobis lateralibus acuminatis vel acutis, interdum rotundis, lobo centrali acuto vel obtuso, raro rotundo, interdum obsoleto, angulo inter lobos laterales 13–21°, lobis lateralibus quam centrali subaequalibus vel brevioribus, marginibus integris; bracteae 0.8–4.5(–5.7) mm longae; flores parvi virelli et aurei erectiusculi, odorem stercoreum exhalentes; coronae filamenta uniseriata vel biseriata, filamentis exterioribus filiformis, aureis, 5–7 mm longis; operculum plicatum; ovarium pubescens; semina 6–8 sulcata.

Perennial climber 2–4 m long, minutely ± puberulent throughout (except laminas) with (0.06–)0.10–0.15(–0.20)-mm suberect or slightly antrorsely appressed trichomes, the shoot tip densely minutely puberulent, becoming moderately (to sparsely) puberulent below. Stem 1.5–5 mm diam., with normal secondary growth below, subterete (drying angular), striate; posture of shoot tip cernuous; phyllotaxy 2/5. Stipules (1.7–)2.5–4.5(–6.0) × (0.2–)0.3–0.5(–0.7) mm, falcate, narrowly lanceolate to linear-triangular, very dark purplish, distally stramineous, yellow, or brown and necrescent. Petioles 0.8–3.5 cm (to 5 cm in juveniles), eglandular, adaxially puberulent, abaxially glabrous or sparsely puberulent. Laminas (4–)6–13(–17.5) × (1.7–)2.5–6.5 cm at fertile nodes, elliptic to narrowly obovate or oblong-obovate in general outline, adaxially glabrous or nearly so with a few trichomes proximally on primary veins, olive

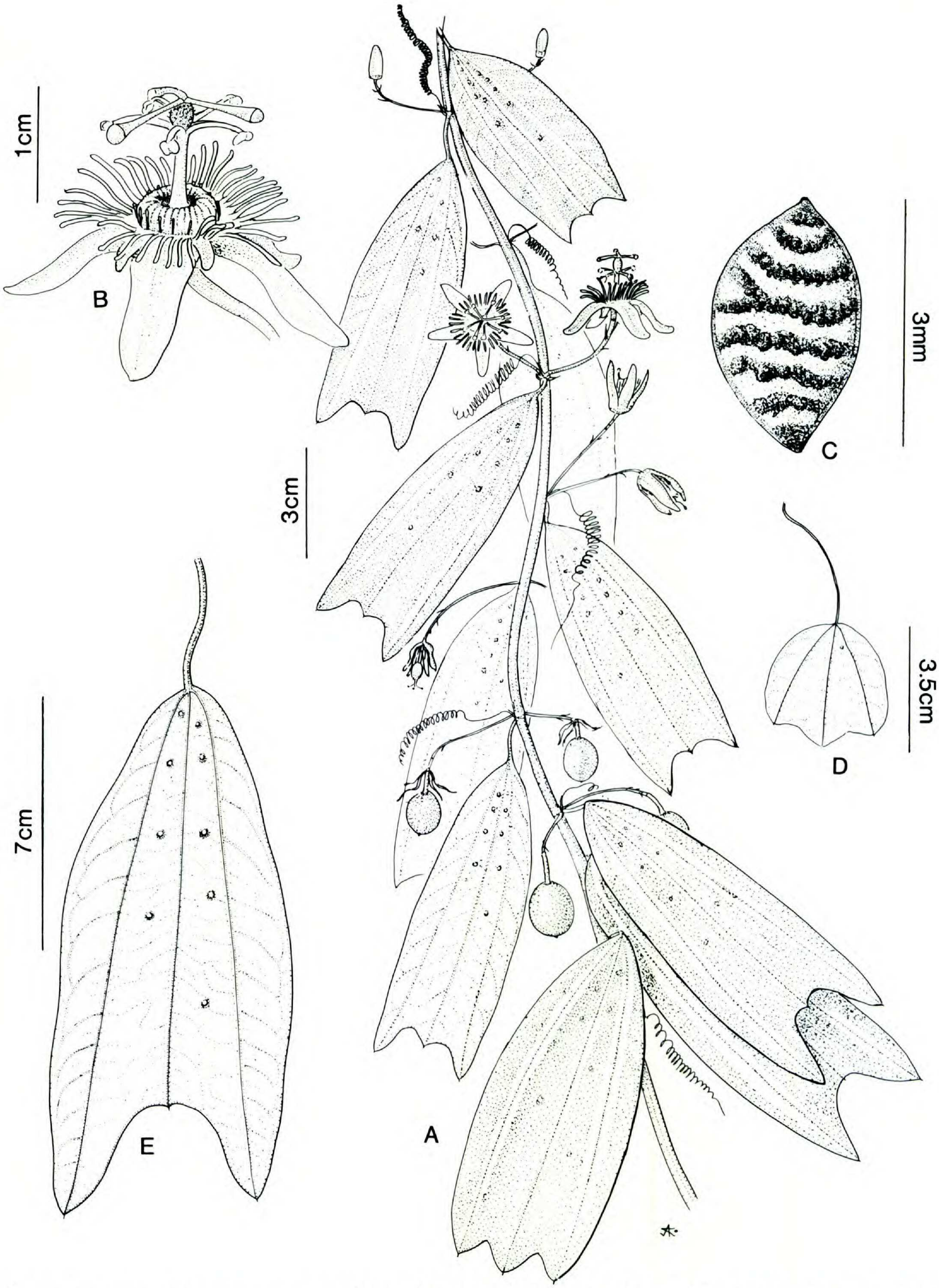

FIGURE 2. *Passiflora gilbertiana*.—A. Habit (*MacDougal 655*).—B. Flower (*MacDougal 655*).—C. Seed (*Gilbert 8*).—D. Leaf of seedling (*MacDougal 1432*).—E. Large leaf from below reproductive nodes (*MacDougal 1431*).

green or flushed purplish, striped with white or pale greenish yellow the length of the 2 lateral veins and sometimes along the basal part of the central vein, abaxially sparsely puberulent to glabrescent with trichomes mainly restricted to the primary and secondary veins, very deep purplish red to very dark reddish purple, becoming greenish on older leaves, the margins entire, puberulent to sparsely puberulent with 0.06–0.10-mm trichomes, very shallowly 3-lobed or shallowly 2-lobed for 0.04–0.15(–0.25) the distance to the cuneate to obtuse (or narrowly rounded) base, the lobes acuminate to acute, sometimes rounded at the very apex, or the central lobe obtuse to obsolete, the angle between the primary lateral veins 13–21°, the ratio of lateral to central vein lengths 0.94–1.2(–1.3), the ratio of laminar width to length 0.35–0.50; laminar nectaries (5–)9–14(–17) per leaf (fewer on seedlings), borne abaxially between the primary veins, ocellate with purple border, appearing light yellowish adaxially, the most proximal pair not strictly axillary or enlarged; leaves of juvenile plants similar, to 18 × 10 cm, with slightly larger lobe angle and relative width; leaves of seedlings with lobe angle 40–60°, central lobe on first leaves longest, then subequal in length, nearly as wide as long. Tendrils straight during development at shoot apex. Prophyll of vegetative ramifying bud 1, broadly lanceolate and often tridentate, acuminate, very dark purple. Peduncles 2.4–3.8(–4.4) cm, geminate, uniflorous; bracts 3, (0.8–)1.7–4(–5.7) × (0.1–)0.2–0.4 mm, linear-triangular, very dark purplish proximally, stramineous, yellowish, or brownish and necrescent apically. Flowers ca. 2 cm diam., suberect, pale greenish with a golden corona, with a strong putrid odor of scatole; floral stipe 4.0–6(–8.0) mm; hypanthium 6 mm diam.; sepals 11–15 × 3.0–4.5(–6.0) mm, narrowly triangular-oblong or lanceolate-oblong, rounded, ecorniculate, lightly but evenly puberulent to apex, very light yellow green on both sides; petals 2.0–3.5 × 1.0–1.5 mm, narrowly oblong-ovate to ovate, rounded, very light yellow-green; filamentous corona in 1–2 series, the outer filaments ca. 46–50, 5–7 mm, strongly spreading and only slightly and simply curved, cylindrical and gradually slightly ampliate toward the rounded apex, pale yellow, yellow-green, or whitish basally, the remainder vivid yellow; the inner filaments (if present) 0.6–1.2 mm, expressed mainly in the sepal sectors, slightly clavate, erect; operculum 1.8–2.4 mm, membranous, plicate, cream to yellow; nectary-trough without raised annulus; limen (disk) ca. 2 mm diam., pentagonal, bright yellow; androgynophore pale at base, dark pink to grayish purplish red distally; staminal filaments connate (6.2–)7.5–8(–9.0) mm along androgynophore, the free portions 5–6 mm, dark pink at base, light yellow-green distally; anthers 2.0–2.2 mm, not marked with purple; ovary 1.8–2.5 × 1.4–2.1 mm, widely ellipsoid to subglobose, densely puberulent, dark green; styles ca. 6 mm, light yellow green; stigmas ca. 1 mm diam., clavate-capitate. Fruit 1.2–1.4 cm diam., subglobose to widely ellipsoid, lightly puberulent, purplish or bluish black; arils translucent white, length unknown; seeds (2.9–)3.1–3.3 mm long, 1.9–2.1 mm wide, 1.1–1.2 mm thick, obovate, nearly symmetric to very slightly campylotropous, transversely sulcate with (6–)7–8 sulcae, the ridges coarsely verrucose or knobbed, the chalazal beak very slightly inclined toward raphe.

Additional specimens examined. COSTA RICA. SAN JOSÉ: clone of Gilbert's type collection cultivated at Duke University 1980–1984, *MacDougal 655* (BM, CR, DUKE, HUA, MEXU, TEX); from type locality, Aug. 1980, *MacDougal 1431* (CR, DUKE, MO), *1432* (DUKE); side roads along the Pan-American Hwy. ca. 10–15 km N of San Isidro de General, near kms 118–116, at the crossing of the Río Paymer, and N along the road from there, 1,500–1,600 m, 8 Aug. 1981, *Taylor 1120* (DUKE); along the Interamerican Hwy. above San Isidro de General, ca. 15 km N at river crossing, 1,500 m, 5 Mar. 1985, *Taylor & Skotak 4771* (DUKE, MO).

Passiflora gilbertiana is remarkable for its variegated reddish purple leaves and stinking golden flowers. It is a member of a species group of Central American passionflowers in section *Decaloba* characterized by bilobed variegated leaves, greenish to yellow perianth, filiform unbanded outer coronal filaments, and notable reduction in the size of the petals relative to the sepals. This group is part of section *Decaloba* but was not recognized by Killip (1938), who scattered its component species among several of his invalid "series" of section *Decaloba*. Within the group, the new species is most closely related to *P. jorullensis* H.B.K. of Mexico, *P. apetala* Killip of Costa Rica and Panama (Fig. 3), and an undescribed relative of *P. apetala* from the mountainous border of Mexico and Guatemala. Its distinctive characteristics include its long narrow leaf with a relatively small interlobe angle and more strongly expressed red to purple coloration, retention of conspicuous laminar variegation at maturity, and yellow flower with small petals and second (inner) series of coronal filaments. The inner series of coronal filaments varies as to presence or absence within the species. In *Taylor & Skotak 4771* the series is well developed, numbering ca. 40; in the type it is absent. However, the cultivation of somatic clones (*MacDougal 655*) from the type plant revealed that the expression of the second

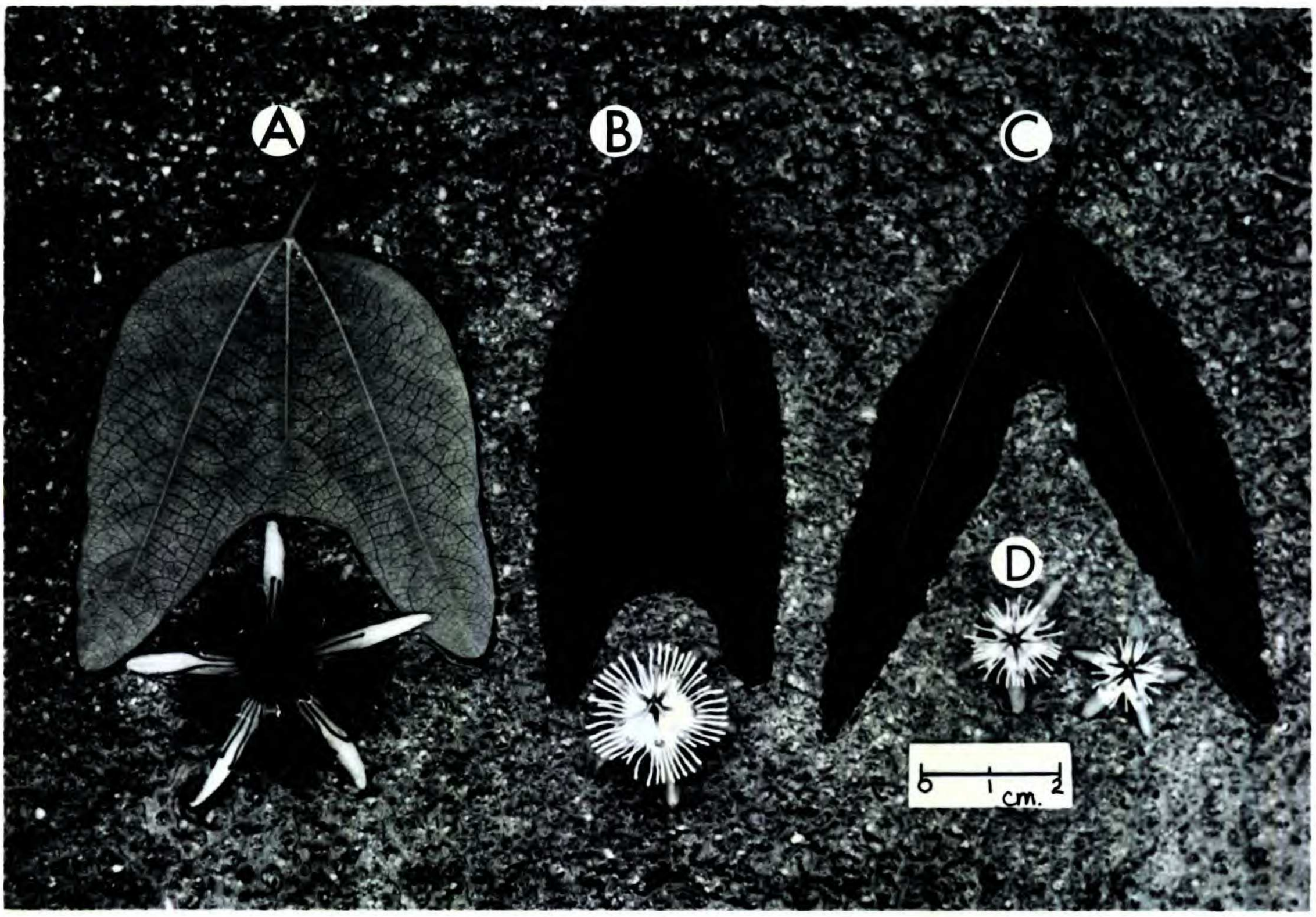

FIGURE 3. Comparison of leaves and flowers of three closely related species.—A. *Passiflora jorullensis* (*MacDougal 368*).—B. *Passiflora gilbertiana* (*MacDougal 655*).—C. *Passiflora apetala* (*MacDougal 467*).—D. *Passiflora apetala*, flower only (*MacDougal 450*).

filamentous series was variable within this individual, with (0–)5–12(–20) filaments per flower. The expression changed gradually along the stem, at times stronger, at times weaker, perhaps dependent on environmental conditions. In certain cases the expression seemed to be related to the position of the flower on the vine, with smaller flowers near the end of flowering axillary branches completely lacking the second series.

On the label of the type is the collector's note "odor of pigpen." The flowers of this new species share this strong odor (described as between "stercoraire et putride" by Planchon, 1849) with *P. jorullensis* (pers. obs.). Gilbert also noted on the type label "visited by hummingbirds," but the same day he also observed a single wasp at a flower (pers. comm.). It is thus probably significant that *P. jorullensis*, with a nearly identical odor, is primarily wasp-pollinated at least in some part of Mexico (MacDougal, unpubl.).

The habitat at the type locality is treefalls and partially shaded thickets along a dirt road on steep slopes in the lower reaches of *Alnus* forest. Plants there climbed over bushes and trailed into small *Alnus* and *Piper* trees. An important herbivore at the type locality is a yellow flea beetle that is an undescribed species of *Monomacra* (from *MacDougal 1431*, voucher identified by C. Duckett, deposited in the Cornell University Insect Collection). Several of the cited specimens show characteristic damage by flea beetles.

A clone from the type collection was cultivated at Duke University and from there was distributed to several commercial greenhouses in California and made available for sale to the public by 1980. In cultivation the plant bloomed from the morning to afternoon, with anthesis around 0930 hrs. and flower closing in mid to late afternoon. The stigmas, although lowered to anther level into the afternoon, were not receptive after ca. 1230 hrs. No fruits were set by autogamy during cultivation, but during limited hand-pollinations, 6 of 11 self-pollinations before 1230 hrs. produced mature fruit containing 19–31 seeds per fruit.

Mr. Patrick Worley, a commercial plant hybridizer, crossed a clone of the type with *P. biflora*, *P. ornithoura* Masters (*MacDougal 623*), and *P. jorullensis* (*MacDougal 368*); many F_1 progeny were grown to maturity and all flowered. Pollen viability was not examined. In each case the unpleasant odor was conserved. One especially ornamental individual of the cross with *P. jorullensis*

was named "Sunburst" and has been available to the public from several nurseries since 1983.

I take great pleasure in naming this species for its discoverer, Lawrence E. Gilbert of The University of Texas at Austin, whose seminal contributions to the understanding of the ecology of the Passifloraceae and their herbivores are well known. Dr. Gilbert first suggested the study of passionflowers to me and has aroused and guided an interest in these plants in many other students. It is particularly gratifying to name this plant because I had the privilege of being with Dr. Gilbert the day he discovered it and gathered the type collection. He immediately suspected it to be undescribed and his exuberance kindled in me what has become a career.

Many of the observations given here were made at Duke University, and I gratefully acknowledge Donald E. Stone for his inspiration and guidance during my graduate studies. Thanks are due the Organization for Tropical Studies for their summer field course that introduced me to Lawrence Gilbert and to these Costa Rican passionflowers. The staff of the Duke University greenhouses provided many years of favorable conditions for passionflower vines, and the Jessie Smith Noyes Foundation generously provided postdoctoral support for research on this family at the Missouri Botanical Garden. The drawings were prepared by John Myers.

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